



1.0 Introduction

A 1989 train derailment, pipeline rupture and subsequent fire stimulated public concern regarding public safety near rail lines adjacent to hazardous liquid pipelines. One of the results of this incident was the passage of California Assembly Bill 385 (Elder). At about the same time, Senate Bill 268 (Rosenthal) was passed as a result of chronic leaks from one of the oldest crude oil pipelines in Southern California.

This report is intended to meet the requirements of both of these bills. It analyzes California's regulated hazardous liquid pipeline risks utilizing leak incident data from January 1981 through December 1990. The California State Fire Marshal, Pipeline Safety Division intends to use the study results to generate a Legislature Report and to propose refinements to current pipeline safety regulations. The latter may include modification of regulatory guidelines governing the construction, testing, operations, periodic inspection, and emergency operations of state regulated hazardous liquid pipelines.

The study was conducted by EDM Services, Inc. Brian L. Payne served as project manager and authored the report, except for Section 5.0 which he co-authored. Dr. Michael O'Rourke co-authored Section 5.0 and performed the seismic risk analysis. Shawn Kanaiaupuni performed the statistical analyses.

1.1 Regulatory Authority

The California State Fire Marshal (CSFM) exercises safety regulatory jurisdiction over interstate and intrastate pipelines used for the transportation of hazardous or highly volatile liquid substances within California. In 1983, the Pipeline Safety Division was specifically created to administer this effort. Mr. James Wait is the current Division Chief responsible for directing the Division.

In 1987, the CSFM acquired the regulatory responsibility for interstate lines when a state certification was executed with the United States Department of Transportation. In doing so, the Pipeline Safety Division became an agent of the Department of Transportation responsible for ensuring that interstate pipeline operators meet federal pipeline safety standards. Specifically, portions of interstate pipelines subject to the agreement between the United States Secretary of Transportation and the California State Fire Marshal are subject to the federal Hazardous Liquid Pipeline Safety Act of 1979, as reauthorized in 1992, and federal pipeline regulations.

The California State Fire Marshal's responsibility for intrastate lines is covered in the California Pipeline Safety Act of 1981, including amendments.

The CSFM Pipeline Safety Division's responsibilities are therefore twofold:

- First, to enforce federal minimum pipeline safety standards and to enforce compliance with such standards over all regulated interstate hazardous liquid pipelines within California; and



Secondly, to enforce the above, as well as the California Pipeline Safety Act of 1981, as amended, on regulated hazardous liquid intrastate lines.

1.2 Circumstantial History

On May 12, 1989, a Southern Pacific Transportation Company freight train derailed in San Bernardino, California. On May 25, 1989, 13 days later, a regulated interstate petroleum products pipeline ruptured. The National Transportation Safety Board summarized this incident in their public information report entitled, Railroad Derailment Incidents Involving Pipelines: 1981 - 1990 as follows:

"A Southern Pacific westbound train lost its brakes as it headed down the Cajon grade toward San Bernardino. After reaching a speed of over 100 mph the train derailed at a curve adjacent to a residential section of San Bernardino. Derailing cars and engines left the track and literally tumbled into several houses, killing two children and two train crew members. All sixty-nine of the cars and five of the locomotive units were destroyed and four others sustained extensive damage.

During the derailment, and later during the movement of heavy equipment to remove the wreckage, a high-pressured gasoline pipeline adjacent to the tracks was damaged and weakened. Less than two weeks after the wreck, the pipeline ruptured and spewed over 300,000 gallons of flaming gasoline into the neighborhood, resulting in two more deaths, serious burns to three others, and the destruction of eleven more homes and 21 vehicles. Total damage to the train and track alone was estimated to be well over nine million dollars with an additional damage estimate to the neighborhood of over five million dollars."

The extremity of this incident stimulated a good deal of public concern. As a result, steps were taken to determine that public safety was not being endangered by the proximity of pipelines to rail lines. One of the results was the passage of California Assembly Bill 385 (Elder).

California Senate Bill 268 (Rosenthal), which was signed by the Governor at the same time, resulted from chronic leaks from one of the oldest crude oil pipelines in the Los Angeles area. These bills included requirements for the State Fire Marshal to perform certain studies which address the risk levels associated with hazardous liquid pipelines on railroad rights-of-way and other factors. Among other things, they required the State Fire Marshal to:

- Study the spacing of shut-off valves that would limit spillage into standard metropolitan statistical areas and environmentally



sensitive areas and, if existing standards were deemed insufficient, to adopt regulations to require the addition of new valves on existing, and new or replacement pipelines.

- Conduct and prepare a risk assessment study dealing with hazardous liquid pipelines which were located not more than 500 feet from any rail line.
- Adopt regulations governing the construction, testing, operations, periodic inspections, and emergency operations of intrastate hazardous liquid pipelines located within 500 feet of any rail line.

These investigations are intended to identify which factors pose the greatest risk to people and the environment due to the likelihood of and the probable severity of a hazardous liquid pipeline accident due to corrosion, third party damage, defect, or other causes.

1.3 Relative Safety Perspective

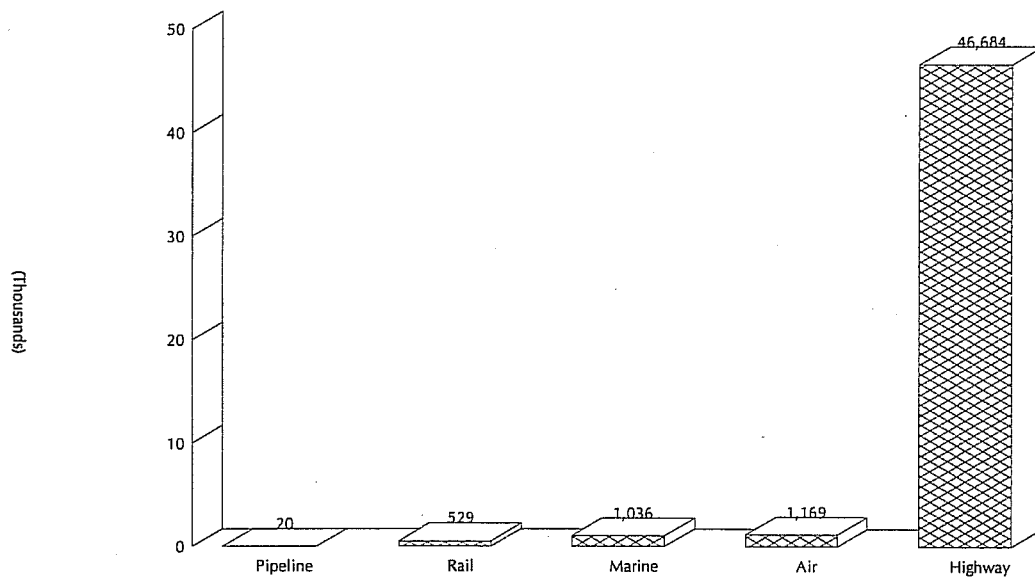
Before we analyze the risks associated with California's hazardous liquid pipelines, it is important to put the relative safety of pipelines versus other modes of transportation into perspective. The United States Department of Transportation, Research and Special Programs Administration's 1990 National Transportation Statistics - Annual Report provides some useful statistics in this regard.

During 1988, there were 49,438 transportation related fatalities in the United States. This data is presented in Table 1-1 by mode of transportation. It should be noted that of the twenty 1988 pipeline fatalities (0.04% of the total domestic transportation fatalities), eighteen of them occurred on gas pipelines. *Only two fatalities resulted from incidents on hazardous liquid pipelines. This represents only 0.004% of the total transportation related fatalities.* (The number of United States hazardous liquid pipeline fatalities per year averaged 3.2 per year for the period from 1978 through 1989.)

In an attempt to compare the relative safety of each transportation mode, we have estimated the fatality rate per billion ton-miles transported. This was done by first determining the number of 1988 fatalities associated with revenue freight. This was performed for each mode of transportation as follows:

- Pipelines - All fatalities were included.
- Rail - All fatalities, including those occurring at grade crossings with vehicular traffic were included.
- Marine - Recreational boating fatalities were excluded.

Table 1-1
Fatalities by Mode of Transportation
1988 National Transportation Statistics





- Air - All general aviation, air taxi, and commuter fatalities were excluded. Since the remaining air carrier data does not differentiate between incidents associated with passenger traffic versus those associated with freight, the resulting number of revenue freight fatalities is unrealistically high.
- Highway - Only truck fatalities were included. Since truck accidents often result in fatalities to those in automobiles, the resulting *truck only* fatality figure is unrealistically low.

The fatality rate was then determined by dividing the number of fatalities by the number of ton-miles transported. The number of fatalities and resulting fatality rates are presented in Tables 1-2 and 1-3. Despite the inherent data errors, the resulting rates provide a very useful method for determining the relative magnitudes of risk to human life. These results are summarized below, using an arbitrarily assigned risk of 1 for pipelines.

• Pipelines	1
• Marine	3
• Rail	40
• Highway	300

In other words, rail transportation results in roughly 40 times more fatalities than pipelines for a given number of ton-miles transported. Order of magnitude comparisons between the other modes could be determined similarly.

A general understanding of these relative risks is essential for those considering regulatory changes which could increase the cost of hazardous liquid pipeline construction, operation, and/or maintenance. Any increases in the shipping costs associated with such changes would likely result in a portion of the throughput being diverted from pipelines to other transportation modes. Since these other modes generally expose the public to a higher risk than pipelines, any such diversion may actually decrease overall transportation safety. For example, if a costly regulation decreased pipeline accidents by say 10%, but diverted some volume to an alternate, less safe mode of transportation, the new result may be a decrease in overall transportation safety.

There are already signs of this occurring, especially in Southern California. The crude from many of the older production fields which was historically transported by pipeline, has been diverted to truck transportation which has the worst safety record.

Table 1-2
Estimated 1988 Fatalities Associated with Revenue Freight
By Mode of Transportation

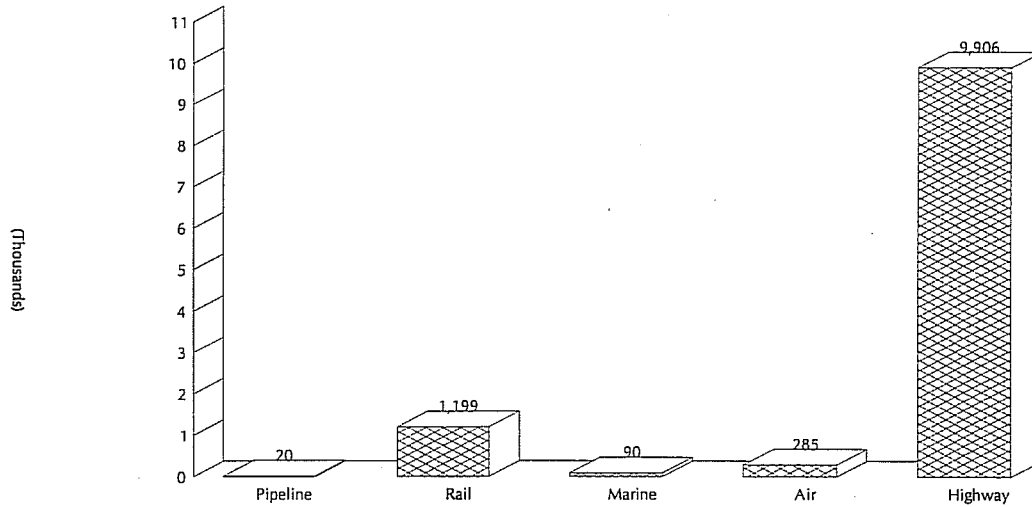
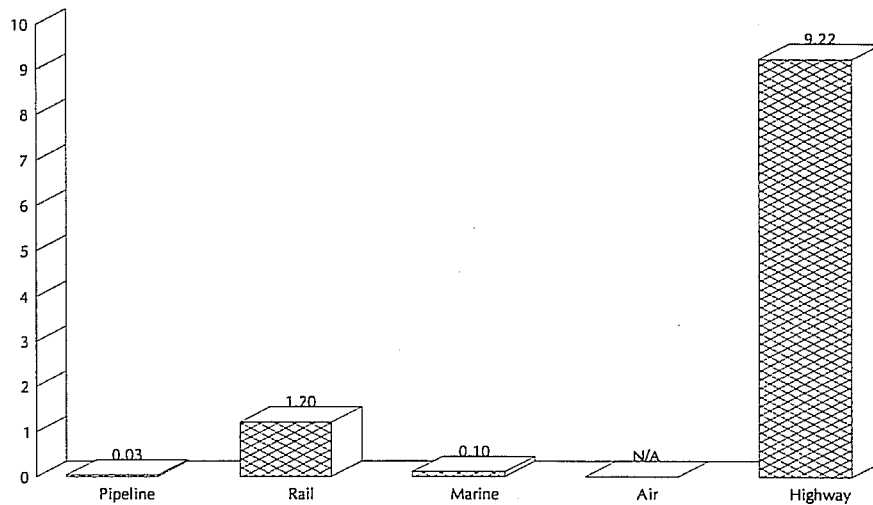


Table 1-3
Estimated 1988 Fatalities Per Billion Ton-Miles Transported
By Mode of Transportation





1.4 Acknowledgements

The detailed analyses and data contained in this report could not have been gathered and presented without the full support and cooperation from each of the pipeline operators. EDM Services and the California State Fire Marshal staffs sincerely appreciate each operator's commitment to pipeline safety as evidenced by their time, effort and financial expenditures made to help compile this data. We have attempted to acknowledge the key contacts from each pipeline operating company who worked directly on this project in Exhibit 1; we apologize in advance for any omissions.

We would also like to acknowledge the Pipeline Safety Division staff for their dedication and assistance with these studies. Without their support and occasional prodding, we may never have completed this extensive effort. Specifically, we would like to acknowledge the efforts of Mr. James Wait, Division Chief; Mr. Chuck Samo, Supervising Engineer, and Mr. Robert Gorham, Associate Engineer.



California State Fire Marshal

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Hazardous Liquid Pipeline Risk Assessment
